SCIENCE

NEW SERIES
VOL. 98, NO. 2545

FRIDAY, OCTOBER 8, 1943

SUBSCRIPTION, $6.00
SINGLE COPIES, .15

Science: published weekly by The Science Press, Lancaster, Pa.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

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VOL. 98 FRIDAY, OCTOBER 8, 1943 No. 2545

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL; WARE CATTELL, assistant editor. Published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

RECENT ANTHROPOLOGY[1]

By the late Professor FRANZ BOAS

FROM time to time I have found it useful to reexamine the general principles which I have been following in my scientific work and to compare them with new tendencies which were springing up in our own and related sciences and which were modifying and extending both the field of our researches and the methods of investigation. It so happens that I have stated the results of such reexamination of principles at intervals of about ten years, beginning in 1888 with the acceptance of views generally held by ethnologists of that period. The last time I gave such a review was in 1932. I have been asked to give to-day a similar review of the problems and methods of anthropology as I see them.

Before the development of field research, planned for the investigation of specific, detailed problems, the endeavor of the field worker used to be primarily to obtain information, as complete as possible, regarding the types of bodily build, of linguistic expression and of other cultural features that set off one human society from others. In 1888, when I was charged by the British Association for the Advancement of Science with an investigation of the Indians of British Columbia, a summary report on the types and customs of the Indians of that province was the task entrusted to me. By necessity it resulted in a picture in which general impressions were combined in a standardized whole. Individual variations within the group had to be neglected. They were not considered as relevant. Furthermore, they can not be obtained by these methods, for they require long-continued personal relations between the observer and members of the group which he wishes to study.

It will perhaps be best to discuss the problems that

[1] Read before the American Ethnological Society, May 13, 1942.

confront the investigator by taking up physical anthropology, linguistics and culture separately because the crucial questions appear partly in different forms.

In physical anthropology it is possible to define generalized groups adequately, provided we confine ourselves to the comparison of such groups in which the characteristic traits of every individual of the one group are distinct from those of the other, as for instance Bushmen and North Europeans, although we must remember that there are other traits in regard to which the two groups are not fundamentally distinct.

The attempts to define closely related populations in which individuals of the same form are not exclusively found in the one group, or to define single traits that are found in the various groups that are being compared present peculiar difficulties. In all these cases differences between the groups can be expressed only by statistical methods, that is, by determining the frequency with which the various forms occur in each group; but this is not the way in which our minds work. We are impressed by those forms which occur most commonly and combine these forms in one individual, the type. It is easy to show that such a "type" is a construct that has no reality. When, for instance, Professor Sargent constructed the ideal type of the Harvard student by having a sculptor make a figure of a youth whose body measurements corresponded to all the measurements obtained as averages of all the Harvard students, he would have been unable to find any individual strictly corresponding to that type. Supposing he had excluded all those who differed very much from his standard and included only those who were near the most frequent forms so that only the middle half of the series were included, and if furthermore ten independent features had been considered, he would probably have found among 1024 individuals just one who corresponded to his ideal type. In other words the type is a subjective construct. Whether it has an objective reality must be determined by special investigations.

It must also be remembered that types described by averages are not of such character that the differences between two types can be expressed by addition or subtraction. The differences between two averages may be the same, but the variants may be such that in one case not a single measure of the one group would appear in the other, or it may be that both groups have many measures in common, and the measure of difference can not be obtained by subtraction, but only by an evaluation of the significance of the number of cases the two series have in common. The numerical values are not additive.

Another consideration must be borne in mind. When a type is described, previous impressions and preconceived notions influence the description of what we see. A person who has studied a Negro population will see the lips and noses of Indians as narrow, while one whose experience has been with Whites will describe them as broad, even if both observers used the same printed standard pictures as types. In an experiment made by Goring, the foreheads of criminals were described as low, because this was expected, while the actual measurements showed that the description was faulty. All this is equally true of anatomical, physiological and psychological traits.

There is another form of mental reaction to the variability found in a population. The forms deviating most strongly from those of most frequent occurrence are readily considered as separate units, to be excluded from the type. In this manner two or more contrasting types may be established, the middle, most frequent form being considered the result of mixture of the extreme forms, either due to interbreeding or to simple mechanical mixture of the extremes. Wherever pairs of contrasting terms are used this tendency may be suspected. Long-headed and short-headed, tall and short, pyknic and leptosome, extravert and introvert are primarily terminological conventions expressing extremes of a variable form. Their designation as types does not show that they should be considered as distinct elements in a population. An example of this kind is the description of Indian types by an experienced anthropologist who described one group of Indians as composed of a number of types of other tribes whom he had previously investigated and whose forms had impressed themselves upon his mind. The study of extreme forms may bring to light correlations between features that may be obscured in the general mass, such as relations between bodily form and function; but it can not decide whether such relation is due to an inner relation controlled by biological conditions, to mixture of distinct variable forms or to other causes. As in other cases, a statistical statement of numerical distribution may give us a clearly defined problem, the answer to which must be sought in the domain of other sciences. When we find that the size of the body of Europeans and Americans has increased during the last century we have to look for an explanation not in statistics, but in the physiology of growth as affected by sociological or other conditions and by possible changes in the hereditary composition of populations; or when the birth rate of a population changes, the social changes, age distribution and so on that bring about the statistical result have to be investigated.

It can not be emphasized too strongly that it is a fundamental logical error to identify the construct type and the individual, to ascribe all the characteristics of the type to the individual, as well as

to mistake a terminological classification for a reality. Such conclusions are scientifically unsound. What is worse, they have a disastrous effect upon our lives. It is clear that the whole Nazi anthropological theory is built up on these misconceptions, on the assumption that members of what is called arbitrarily a racial unit—actually a population—must have individually certain traits in common which conform to the construct type; all this notwithstanding the stress laid upon the hereditary differences in family lines.

The concept of a pure race implies that all individuals constituting the "race" must be genetically alike. The only pure races that we know are pure-bred domestic animals and cultivated plants and these are purest only in regard to those traits that can be bred pure and that have been selected for pure breeding. The variability of the whole race is low in regard to the selected features and all the family lines are very much alike. The question, in how far fraternities in highly inbred human societies are alike and in how far family lines may be alike in such a community has never been adequately studied. From what we know at the present time we may say that even in highly inbred communities a high degree of variance of family lines as well as of members of fraternities persists, so that the identification of an individual as a significant sample of the group is impossible. The larger the area inhabited by the social group under consideration—generally a nation is meant—the less can any individual be considered as representative of the group, the less can we speak of the "type" of a nation.

There is another very fundamental problem in physical anthropology that has not received adequate attention. A local type is generally considered as stable. Racial heredity means that the typical distribution of forms of one generation will be repeated in the following generation. It has been recognized that differential birthrate, mortality and migration may modify the frequency of various types, but insufficient stress has been laid on the question in how far the children of parents of a given form may differ for physiological reasons from their parents, in other words in how far external conditions may modify the type. We know that lower organisms are susceptible to such changes, but there is still considerable reluctance to accept this problem as one of major importance.

Let us turn from the field of physical anthropology to that of cultural anthropology. In earlier years the attention of students was primarily directed to the problem of the general development of culture, to the discovery of evolutionary stages of culture and to the investigation of historical events that shaped cultural development. The results of these studies will always retain their importance for an account of the history of culture. Archeology, the study of distribution of similar cultural forms, the occurrence of isolated inventions or ideas in regions without apparent historical connection furnish data necessary for the solution of these problems. Except in so far as technical improvement of methods of research is concerned there is little to be said that is new. The importance of continuing this work, of collecting new data in unexplored regions should, however, be emphasized. The interest in new lines of inquiry that has developed during the past twenty or thirty years should not induce us to slight this indispensable field of work.

The description of a type of culture brings up the question of the meaning of the term type in a form somewhat different from the one it has in physical anthropology. As in the morphological description of bodily forms we find in some groups traits which are common to one group and never occur in another one—like the differences between the pigmentation of North Europeans and Negroes—so we find in cultural groups characteristics that differentiate one group fundamentally from another. Such traits are a common language, principles of family organization, motor habits, food and sleeping habits and the like. In all these, individual variations, if they occur at all, are insignificant. Unlike the common anatomical characteristics the traits here referred to are not biologically determined. They are either automatically determined by subconscious, involuntary imitation, or deviations from the norm are so intensely frowned upon by the community that conformity is brought about by coercion.

For this reason the impressionistically derived concept of typical cultural behavior has a much higher degree of reality than that of a physical type. In a simple tribe all individuals speak the same language. They have the same kinds of industries, obtain and use food and shelter in the same way. Groups of the same descent, strictly comparable in bodily form, may differ fundamentally in cultural form. The pattern of culture has greater reality than the biological types because the cultural pattern exerts its influence equally upon every individual, while biological descent produces individuals of different qualities.

Nevertheless, we must recognize that individual variations in behavior exist, dependent upon personality and individual experience. The conditions under which most ethnological work is carried on make it difficult to observe individual variations of behavior, and little material is available for a study of this subject.

One of the characteristic traits of modern anthropology is the emphasis laid on the relation between

individual and culture, from two points of view, the shaping of individual behavior by the culture in which the individual lives, and the modification that culture undergoes by the behavior of the individual. The latter is obviously needed for an understanding of the dynamics of cultural changes.

Before speaking on this subject some remarks are necessary on the problems presented by attempts to describe and analyze a culture.

One of the serious difficulties that has never been adequately dealt with is the lack of a precise understanding of the concepts with which alien cultures are operating. These must be obtained from a detailed study of the semantics of the language of the people whose culture we wish to study and this can be obtained only when we have the fullest data that allow us to determine the meaning of the expressions used. Words like "good" and "bad," for instance, have no content unless we know what is good and what is bad. Does "good" cover the ideas of useful, right and beautiful, or is it confined to the concept of useful? Our knowledge of the semantics of primitive languages is wholly inadequate, and still, without it, we can not understand the world in which they live. On the whole our dictionaries are exceedingly inaccurate, even in the translations of material objects or of actions performed with or on material objects. In some languages our term "to break" is not the same concept when applied to long, round or flat objects, although always done by pressure. To sing is not the same, if the song is without words or with words, a dance song, love song or sacred song. "To love" may emphasize the ideas of value, of friendship, or of sexual love and may include the concept of pity. Accuracy of semantic value is particularly demanded in all discussions of religious subjects on account of the vagueness of many of these concepts. Thus it is of prime importance to know that in Bantu languages the being that is generally translated as "God" belongs to the class of inanimate things and can not be conceived as a human or living being. The long discussions about mana and animism might have been avoided, if the semantic value of the terms had been clearly understood. The same may be said in regard to the term soul, which has no equivalent in any primitive language that I know. Life, will power, personality, the memory image of a person, may all be considered as partial equivalents of what we call soul. For a correct understanding of what the speaker has in mind we must know the exact semantic value of the term he uses. I believe that a strict insistence on a better knowledge on the semantic values of words is necessary for a correct interpretation of the thoughts expressed in language.

The methodological problem here touched upon is closely related to that of the classification of forms of primitive life. In natural sciences we are accustomed to demand a classification of phenomena expressed in a concise and unambiguous terminology. The same term should have the same meaning everywhere. We should like to see the same in anthropology. As long as we do not overstep the limits of one culture we are able to classify its features in a clear and definite terminology. We know what we mean by the terms family, state, government, etc. As soon as we overstep the limits of one culture we do not know in how far these may correspond to equivalent concepts. If we choose to apply our classification to alien cultures we may combine forms that do not belong together and separate what belongs together. The very rigidity of definition may lead to a misunderstanding of the essential problems involved. Goldenweiser, in his discussion of totemism, has demonstrated the error to which the definition of the term totemism has led. As explained before, the discussion of the meaning of the concept "soul" can not be based on the assumption that the classification based on our concept can be transferred to an alien culture. When the idea of a soul is that of a tangible object it would have to be grouped with the tendency to classify qualities as substances—such as sickness, success in hunting or gambling—which may stay with a person or leave him. If it is our serious purpose to understand the thoughts of a people the whole analysis of experience must be based on their concepts, not ours.

Let us turn now to a consideration of the relation between the individual and the social medium in which he lives. We may distinguish between the generalized drives expressed in sex-relations, parental relations, relations to other members of the group, etc., which are the subject of a general social psychology; and our particular problem, the interaction between individual and society in different types of cultures. The subject is so recent that a critical examination of the various methods that are being tried is much needed.

Notwithstanding the compelling force of social behavior there is obviously a considerable variation in individual reaction to given standards. As said before, the impressionistically derived typical form of behavior must not be confused with the actual individual behavior which is not identical with the assumed norm. The few available life histories of individuals in primitive societies who changed the political, religious or economic lives of their tribe fellows illustrate the importance of the deviating behavior of individuals.

(To be concluded)

RUNNING RECORDS

By Dr. ALFRED W. FRANCIS

WOODBURY, N. J.

CONSIDERABLE popular interest has developed in running records especially as a result of the recent visit to this country of the Swedish runner, Gunder Haegg, with his seven world's records. There seems to be inadequate means of correlation of records with distance; or more specifically to determine which of two records at different distances is the better. According to newspaper reports the runner himself can not choose among his own records.

It is obvious that a runner can maintain a higher speed for a short run than for a longer distance, but the relation between these speeds and distances is complex. The proper correlation is by a curve through a few of the best records, the others all falling more or less below it, since no record could be better than perfect.

A logical plot is that of average speed in meters per second against the logarithm of the distance as in Fig. 1. The use of the logarithm permits plotting of a wide range of distances without undue crowding at the left end. The curve drawn, with dotted portions at each end, is the plot of the equation,

$$(\log D - 1.5)(V - 3.2) = 6.081$$

which is a hyperbola with a vertical asymptote at 1.5 and a horizontal one at 3.2m/sec. The former is simply equivalent to using a unit of 31.6m in measuring the distance. The latter has a real physical significance, being for a "perfect runner" the "dog trot" velocity. This can be defined as the speed which he could maintain indefinitely without tiring (if it were not for lack of sleep, nourishment, etc.). He can maintain a slightly higher average speed for a finite long distance, or a considerably higher speed for a short distance, either effort producing temporarily complete exhaustion.

The records for less than 400 meters fall below the hyperbolic curve because other factors prevent a runner from attaining such a speed which would exhaust him in those distances. A tangent to the curve is drawn through the record for 220 yards. The records beyond one hour fall below the dotted curve because such races are seldom run under ideal conditions of course and weather; and because other forms of tiring, such as lack of nourishment, enter in. A straight line is drawn through the points for one hour and the marathon. The normal tiring for the large mid-portion of the plot is probably mostly a function of the oxygen concentration in the blood.

The scale of Fig. 1 is too small to permit accurate comparison of different records. This is accomplished in Fig. 2 in which the ordinate is the left-hand side of the equation.

The record for 5,000 meters is clearly superior to most of the other records. In fact, if it were five seconds slower, the straight dotted line, which nearly passes through seven other points, would correlate the best records nicely. By readjusting the constants of the equation the 400-meter record (which has been run twice) and either the 800-meter record or that for one hour (but not both) could be placed in a horizontal line with the 5,000-meter point, all other records being

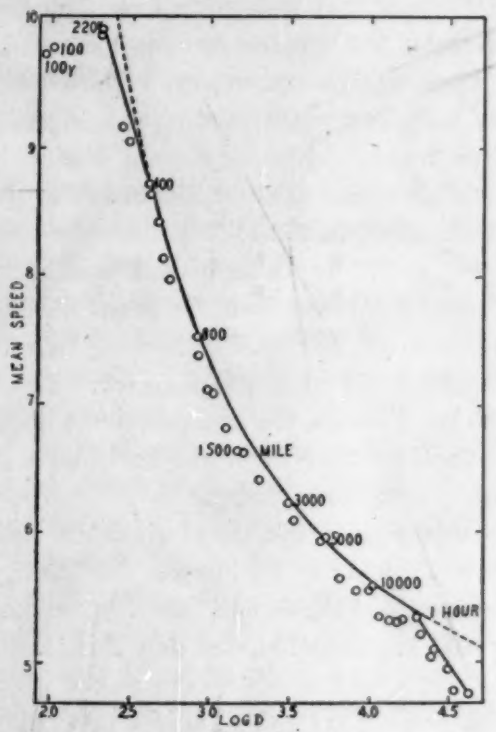

FIG. 1

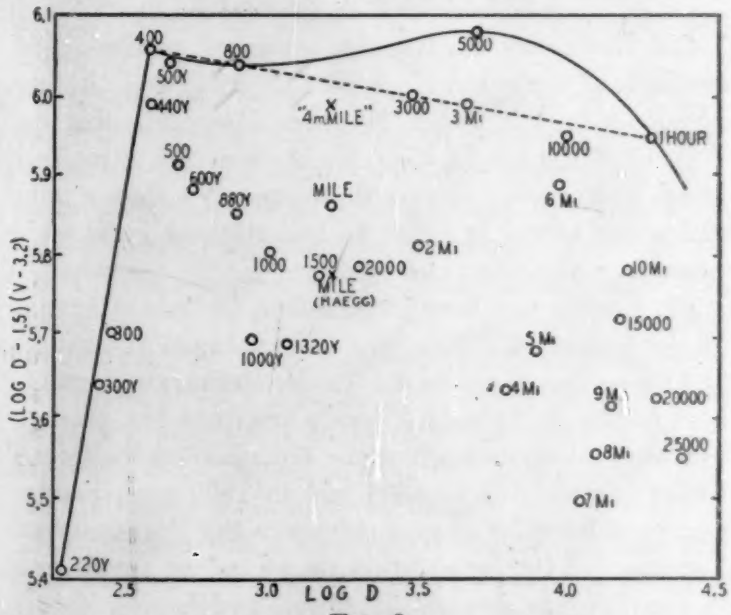

FIG. 2

inferior. This is not done, however, because the choice between the 800 meter and one hour would be arbitrary; and because any new record above the line would require a recalculation with distortion of the whole plot. It is believed that the plot as shown gives a fair comparison between the records. Tentatively a smooth S curve is drawn through the four records mentioned, and is considered to represent the present limit of human speed.

The plot shows that four of Haegg's seven records, the 1,500 and 2,000 meters, his one mile and the two mile, are practically equivalent. The 3,000 meters and three mile are much better, but inferior to his 5,000-meter record. The new mile record by Arne Andersson in Sweden of 4: 02.6 is closer to the curve; but even the hypothetical "four minute mile" falls short, and is therefore an imminent possibility.

A straight line is drawn between the 400-meter point and that for 220 yards, showing that those for 300 yards and 300 meters are inferior. The break at 400 meters is of course too sharp, but the abrupt drop is due to the fact that races shorter than 400 meters are not completely exhausting.

The records used in the calculations are those given in the New York World Almanac for 1943, whether officially accepted as world's records or not. Two other records are included, the new mile record made on July 1, 1943, and the 500-yard record of 54.4s. by Borican on June 13, 1940. Table I gives the records for the more usual distances with the products plotted in Fig. 2, and the calculated records corresponding to the curve of Fig. 2. Calculated times for other distances can be found readily by interpolation. Any actual time for a race can be compared with the calculated world's record on a percentage basis, either time for the same distance or, what is more sound theoretically but less convenient, relative distance in the same time; since that represents the relative accomplishment of an inferior runner as compared with that of a "perfect" runner in the same time.

TABLE I

WORLD'S BEST RUNNING RECORDS

Distance	Product*	Time computed	Time actual	Per cent.
100 yd	....	....	9.4s	
100 m	....	....	10.2s	
200 m	5.33	20.16s	20.3s	99.3
220 yd	5.39	20.3s	20.3s	100.0
400 m	6.057	46.0s	46.0s	100.0
440 yd	6.043	46.34s	46.4s	99.87
800 m	6.041	1m 46.6s	1m 46.6s	100.0
880 yd	5.860	1m 47.33s	1m 49.2s	98.26
1,000 yd	5.697	2m 4.7s	2m 8.8s	96.82
1,500 m	5.771	3m 40.4s	3m 45.8s‡	97.61
1 mile	5.860	3m 58.7s	4m 2.6s	98.19
2,000 m	5.788	5m 4.8s	5m 11.8s	97.66
3,000 m	6.000	7m 58.6s	8m 1.2s	99.46
2 miles	5.815	8m 37.2s	8m 47.8s	98.00
3 miles	5.993	13m 26.6s	13m 32.2s	99.31
5,000 m	6.081	13m 58.2s	13m 58.2s	100.0
5 miles	5.687	23m 26.5s	24m 6.2s	97.25
10,000 m	5.950	29m 39.8s	29m 52.3s	99.30
10 miles	5.784	49m 35.0s	50m 15.0s	98.67
19,210 m	5.946	One hour	One hour	100.0

* $(\log D - 1.5)(V - 3.2)$ D in meters, V in meters/sec.
‡ Since this paper was written, Andersson has run 1,500m in 3m 45s.

OBITUARY

LEWELLYS F. BARKER

DR. LEWELLYS F. BARKER, emeritus professor of medicine of the Johns Hopkins University and visiting physician to the Johns Hopkins Hospital, died on July 13 at the age of 75 in his home at 208 Stratford Road, Baltimore. His death brought to a close a long and active career in which he had attained great eminence as a physician and teacher.

Dr. Barker was born in Norwich, Ontario, Canada, on September 16, 1867. His father, James F. Barker, and his mother, Sarah Jane Taylor Barker, were members of the Society of Friends and thus Dr. Barker was brought up as a Quaker. He attended Pickering College from 1881 to 1884 and in 1890 received the degree of bachelor of medicine from the University of Toronto. After graduation he served as an interne in the Toronto General Hospital, and having determined that the Johns Hopkins Hospital was the institution in which he wished to continue his medical studies, he came to Baltimore, and was appointed assistant resident physician by Dr. Osler. This marked the beginning of Dr. Barker's distinguished services to the Johns Hopkins University and Hospital.

During these early and busy years he worked in close association with Osler, Welch and Mall, and it was not long before it was realized that this young assistant possessed a mind of unusual quality and capacity. Dr. Franklin P. Mall, the professor of anatomy, was one of the first to give expression to this feeling and in 1894 selected Dr. Barker to fill the position of associate in his department; and in 1897, at the age of 30, Dr. Barker was made associate professor of anatomy. Under Mall's influence, Dr. Barker became absorbed in a study of the nervous system. This resulted in his first important and extensive contribution to medicine which took the form of a book entitled "The Nervous System and its Constituent Neurones."

A trip abroad to work in Germany with von Fry, Flechsig and His was soon followed by a noteworthy distinction, for in 1900 he was invited to take the chair of anatomy at the University of Chicago. Pre-

vious to his departure from Baltimore, however, there had been an opportunity to work in the pathological department at the Johns Hopkins University, and to make two important expeditions, in company with Dr. Simon Flexner; one to the Philippines on the Johns Hopkins Medical Commission, and the second to San Francisco on a commission sent by the Government to determine the existence or non-existence of bubonic plague in that city.

In 1903 Dr. Barker married Miss Lillian Haines Halsey, and later when they made their home in Baltimore, their house became a center to which innumerable friends from home and abroad were welcomed with the greatest hospitality.

While Dr. Barker was professor of anatomy at the University of Chicago, he published an article on the whole-time teaching of clinical subjects. This paper attracted some attention and when Dr. Osler resigned the chair of medicine at the Johns Hopkins University in 1905 to go to Oxford, Dr. Barker was selected to fill this post. It was not, however, possible at that time, to place the department on a full-time basis.

The appointment was a somewhat unconventional one, for Dr. Barker had had little practical experience in clinical medicine. Nevertheless, he returned to Baltimore equipped in other respects in an unusual manner to develop along progressive lines the excellent medical clinic which already existed, for he not only had experience and training in one of the preclinical sciences, but had spent a year working with Friedrick Müller in Munich and with Abderhalden in Emil Fischer's laboratory in Berlin. Endowed with remarkable intellectual qualities, a gift for teaching and unusual executive ability, Dr. Barker enlarged the facilities for investigation, and with much foresight developed the first medical clinic in the country in which well-equipped laboratories for research in chemistry, in physiology and in infectious diseases and immunity formed an integral part of the department. This elaborate extension of the arrangement which then existed was an innovation and an important contribution.

In his practice, he soon came to appreciate the need of emphasizing special examinations, which were rapidly being made available through new techniques, for obtaining information concerning the diseased state of his patients. In the course of these intensive studies, attention was directed not only to the various physical abnormalities, but to the hereditary traits, the emotional reactions and the mental characteristics of the individual; and in order to accomplish this successfully, it was desirable that a small group of physicians, surgeons and specialists should work in close cooperation. Only when the data, obtained in this manner, were analyzed, correlated and coordinated, could a comprehensive diagnosis be arrived at, and what Dr. Barker termed a correspondingly "multidimensional" therapy instituted. It is not surprising that he should have been particularly attracted to a study of the anatomical and functional disturbances of the nervous system, and that first, having laid stress upon the personality of the patient, he should later lay emphasis upon the individual as a complicated and indivisible whole. These were principles which dominated his practise, and which brought him phenomenal success. His knowledge led many groups to seek his advice, not only concerning matters of physical well-being, but involving problems of social welfare.

His interests grew in number and widened in scope and when it became financially possible through the generosity of the Rockefeller Foundation for the Johns Hopkins University to place some of the clinical departments on a full-time basis, Dr. Barker found it impossible, on many accounts, to accept the headship of the department of medicine on this basis. He remained, however, an active and brilliant member of the staff for the remainder of his life, acting as a member of the medical board of the hospital, of which he was chairman for many years, and conducting clinics, the last series of which he completed only a few weeks before his death.

His quick and retentive mind, his wide and remarkably varied interests, his systematic methods of intensive study and concentrated reading, resulted inevitably in an accumulation of knowledge which was almost encyclopedic. This was reflected in his brilliant clinics and lectures, in his addresses and in his numerous articles and treatises which touched almost every phase of medicine. His last book, published scarcely a year before his death, was an autobiography entitled, "Time and the Physician."

He was a member of a great number of medical and scientific societies, and acted as president of many, including The National Committee for Mental Hygiene (1909–1918), the Association of American Physicians (1913), the American Neurological Association (1916), the Southern Medical Association (1919), the Association for the Study of Internal Secretions (1919) and the Medical and Chirurgical Faculty of Maryland (1923). He received the honorary degree of doctor of laws from Queens University, Canada, in 1908; from McGill University in 1911 and from the University of Glasgow in 1930.

Dr. Barker was a conspicuous figure in American medicine. His somewhat stately gracious manner, his height, his white hair and, above all, his long delicately formed hands impressed every one who came in contact with him. There have been few physicians in this country who were more learned in the various

branches of medical knowledge, more widely versed in the affairs of man or more interested in the human being than Dr. Barker.

WARFIELD T. LONGCOPE
THE JOHNS HOPKINS HOSPITAL

RECENT DEATHS

DR. ROSCOE RAYMOND HYDE, professor of immunology and director of the laboratories of immunology and filterable viruses of the School of Hygiene and Public Health of the Johns Hopkins University, died on September 15 at the age of fifty-nine years.

DR. BERT CUNNINGHAM, professor of biology at Duke University, died on September 27 at the age of sixty years.

DR. J. WILLARD HERSHEY, head of the department of chemistry of McPherson College, Kansas, known for his work on rare gases, died on September 27 at the age of sixty-seven years.

STEWART H. BURNHAM, who retired recently after serving for more than twenty years as assistant curator of the herbarium of the department of botany of Cornell University, died on September 25. He was seventy-two years old.

DR. ARTHUR A. TICKNOR, divisional chemist for the Calco Chemical Company of Bound Brook, N. J., a subsidiary of the American Cyanamid Company, died by suicide on September 26. He was fifty years old.

DR. GEORGE BACHARACH, assistant professor of chemistry at Brooklyn College, died on September 20, at the age of fifty-five years.

SCIENTIFIC EVENTS

AIRCRAFT PRODUCTION IN GREAT BRITAIN

THE Select Committee on British National Expenditure, in a report on Aircraft Production issued recently, states, according to *The Times*, London, that the aeronautical industry in Britain is suffering from an acute shortage of scientific and technical men. It is stated that there are not enough adequately qualified men available to maintain the industry at the proper level of efficiency. This shortage applies also in the whole field of aeronautical research, including the official establishments, and it is said to have been clear for some time that there is more work than can be done by the existing personnel. The report continues:

> Special measures are therefore necessary. Men of high academic, scientific or technical attainments should not be allowed to be absorbed in the fighting services, where, even when they are employed in technical jobs, their qualifications are often much higher than is needed. More pre- and post-graduate courses in aeronautics are needed at the universities, especially in view of the fact that facilities for training which were available in the industry in peace-time are now used for training R.A.F. personnel. The committee recommends that the appropriate departments should investigate the facilities available for training research workers, aeronautical engineers and other technicians in order to determine what action is necessary to meet requirements.
>
> There is a similar shortage of adequately qualified staffs in all grades of management. The enormous expansion of the industry has entailed the up-grading of large numbers of men with relatively little experience, and it is freely admitted by managements that they have had to promote many men whom they would not normally so promote. Little appears to have been done to remedy the deficiency. In the case of foremen the situation has been worsened by the fact that there is frequently reluctance to accept promotion. In a few cases, the existence of high piece-rate earnings may partly explain this reluctance, but the more general reason is undoubtedly simple unwillingness to accept responsibility. This is not unnatural when it is remembered that relatively few workmen are of long standing in this industry. To remedy these deficiencies the committee recommends that courses should be provided to train foremen for higher grades, and that more use should be made in the Ministry of Labor's courses in foremanship.
>
> The report points out that one of the most disturbing features in regard to the supply of labor for the industry is the high rate of wastage. In the present general shortage of labor it is necessary for firms to engage persons who for one reason or another are not ideally suited for the work. The committee considers that the rate of wastage disclosed is greater than it should be, and that action should be taken by the Ministries of Labor and Aircraft Production to reduce it.

OPHTHALMOLOGICAL RESEARCH AT THE UNIVERSITY OF OXFORD

THE University of Oxford is planning the establishment of a department for ophthalmological research, the activities of which would include research, teaching and the treatment of patients. The Ophthalmological Research Endowment Committee is asking for help in raising £250,000 to build, equip and endow the research laboratories of a department of ophthalmology at the university. Contributions received during the war will be invested in Government securities. The treasurer of the Ophthalmological Research Endowment Fund, Old Clarendon Building, Oxford, will receive contributions. Expenses of the appeal

are being met by the generosity of the National Institute for the Blind. *The Times*, London, reports that

> The facilities available for such work are considered wholly inadequate, and the university is appealing for funds towards the establishment of research premises in connection with the Oxford Eye Hospital, the rebuilding of which will be begun at the end of the war; the provision of salaries for full-time and part-time research workers, teachers and technicians engaged in the new department; and the defraying of the working costs of researches which would have for their aim the prevention of blindness, the improved treatment of eye disease and the promotion of a higher standard of visual function throughout the country.
>
> Under the proposed regional scheme of the Joint Hospitals Board, the Oxford Eye Hospital will become the chief regional center (covering the counties of Oxford, Buckingham and Berkshire) for ophthalmological work and teaching. For this the present hospital is inadequate, and is to be rebuilt, the necessary funds being raised by a separate appeal from local sources.
>
> One of the problems which the proposed department at Oxford would examine would be that of discovering the safest anti-bacterial drugs for ophthalmological purposes. The extreme delicacy of the eye is the governing consideration, as all the usual antiseptics are poisons, and further investigation will need contributions not only from ophthalmology, but bacteriology, mycology and chemistry. The most promising substance found so far is penicillin, the development of which is largely the result of work done in an Oxford laboratory.
>
> The Oxford scheme, which will be generally welcomed, will form an important contribution towards the great national effort that is being made to abate the toll and suffering and economic wastage due to loss of sight and defective vision. Statistics prove that, while failure of vision is a hazard common to all, the risk falls increasingly on those who are in middle and later life. In 1941 out of a total blind population of 74,000 in England and Wales, 63,000 were persons over 40 years old.

REHABILITATION CLINICS AT THE NEW YORK HOSPITAL

A PSYCHIATRIC rehabilitation program which it is hoped may point the way toward reclamation of the estimated 80,000 New York City men thus far rejected or discharged from military service because of mental illness has been initiated by the Payne Whitney Psychiatric Clinic of the New York Hospital.

Recognizing that the thousands of men who have proved unsuitable material for the Army, Navy and other services because of psychoneurosis constitute a wartime emergency problem that will exist and grow, even after the war, the hospital has established a special out-patient clinic that is already functioning and the full resources of the clinic will be devoted to patients' rehabilitation. The integration of psychiatric treatment with the psychological testing, retraining and employment resources of an actual community is to be emphasized in the program.

Originators of the plan are Dr. Thomas A. C. Rennie, attending psychiatrist at the clinic and associate professor of psychiatry at Cornell University Medical College, who will direct the program, and Mrs. Melly Simon, chief of psychiatric social service. Dr. Rennie was recently named director of the Division of Rehabilitation of the National Committee on Mental Hygiene. Basic funds to start the clinic have been granted by the Commonwealth Fund.

The clinic is staffed by New York Hospital psychiatrists, psychoanalysts and social workers, all of whom are serving on a voluntary basis, and it is expected that by mid-October fifteen or more such volunteer psychiatrists will be actively at work. In addition to the New York Hospital volunteer staff, other psychiatrists in the city have signified their willingness to participate in the same kind of project.

Among social service agencies having evidenced their interest and willingness to cooperate with the program are the New York City Committee on Mental Hygiene, the National Committee on Mental Hygiene, the Social Security Board, the U. S. Employment Service, the Vocational Adjustment Bureau, the American Rehabilitation Committee, the Community Service Society and the Y.M.C.A. Arrangements have also been made for the referral of cases to the clinic by the State Selective Service Board.

According to Dr. Rennie, the clinic will fulfil two main functions: one, as an actual treatment center for men in need of rehabilitation and, two, as a fact-finding agency to determine the extent of the problem, the amount of help necessary for rehabilitation, the nature of psychiatric disabilities and what percentage of the patients treated may eventually be re-employed.

NEW FLORAS PUBLISHED BY THE NEW YORK BOTANICAL GARDEN AND THE UTAH STATE COLLEGE

BETWEEN the State Agricultural College of Utah and the New York Botanical Garden an agreement was signed in July by which the two institutions will cooperate in the field work for and the preparation and publishing of two important floras: (1) A Manual for the State of Utah and (2) A Flora (illustrated) of the Intermountain Region.

Both of these projects had been started by Dr. Bassett Maguire during the years he spent at the State College in Utah. Now, as curator at the New York Botanical Garden, he will be enabled to continue his work of collecting and writing on the plants of these regions, while his successor in Utah, Professor A. H. Holmgren, will aid in the work. Three more summers of exploration are planned: 1944 to complete the work

in the State of Utah, 1945 and 1946 to be spent in western Nevada and eastern Oregon and Washington, and 1947 to be devoted to a final round-up of the entire intermountain area.

The two institutions are to share equally in all collections, and while the writing of the proposed floras becomes jointly the responsibility of both, the publication of the Manual for Utah is to be largely the responsibility of the Utah State Agricultural College, while the publication of the Flora of the Intermountain Region is to be mainly the responsiblity of the New York Botanical Garden. This region, which has never been adequately or completely treated floristically, is the only major physiographic area of the country that has not heretofore come under the influence of the Botanical Garden, and it is the region perhaps least known botanically.

A VISITING PROFESSOR TO CHINA

DR. GEORGE B. CRESSEY, as already reported in SCIENCE, has been appointed a visiting professor in China by the Department of State, and concurrently will serve as representative in China of the National Academy of Sciences. He is leaving for Chungking this month and will return to the United States next summer.

The appointment is a part of the program of the department of cultural relations, and is designed to strengthen the ties between the United States and China. Professor Cressey will visit and lecture at various Chinese universities and research centers in order to bring the greetings of American scientists to their Chinese colleagues. Most Chinese universities have been obliged to take refuge in the interior and are seriously in need of contact with the outside world. Although it is impossible to send books and apparatus, the Department of State has arranged to forward microfilm copies of professional publications from the United States.

Professor Cressey has been chairman of the department of geology and geography at Syracuse University since 1931, and is on leave for this assignment. Prior to 1931 he taught at the University of Shanghai. He is the author of "China's Geographic Foundations" and a new volume entitled "Asia's Lands and Peoples." Professor Cressey is also chairman of the Committee on Asiatic Geography of the National Research Council, and is one of the recognized authorities in his field. He served as consultant to the Chinese Government in 1934 and to the Soviet Government in 1937.

THE AUTUMN MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY

THE autumn general meeting of the American Philosophical Society will be held on November 19 and 20, beginning at 10 A.M. on Friday, November 19. For guests invited by the society and for members from a distance the society will, as usual, meet the regular hotel charges for rooms during the period of the meeting and for such meals as are not otherwise provided for by the society. Those desiring such accommodations should notify the society as soon as possible.

On Friday morning, November 19, there will be papers chiefly by recipients of grants from the research funds. The afternoon and Saturday morning sessions will be devoted to a "Symposium on the Organization, Direction and Support of Research." On Friday evening, President James B. Conant, of Harvard University, will speak on "The Advancement of Learning in the United States in the Post-War World." This will be followed by a reception. Before the open session on Saturday morning, there will be an executive session of the members of the society.

L. P. EISENHART,
Executive Officer

SCIENTIFIC NOTES AND NEWS

THE Manly Memorial Medal of the Society of Automotive Engineers was presented at the Los Angeles meeting to John Dolza and Harry C. Karcher, of the Allison Division, Indianapolis, of the General Motors Company, in recognition of their work on "Correlation of Ground and Altitude Performance of Oil Systems." The award was established in 1928 to honor Charles M. Manly, designer of the forerunner of modern radial airplane engines.

DR. EDWIN B. HART, professor of agricultural chemistry at the University of Wisconsin, was a special guest and the main speaker at a dinner given by the division of agricultural and food chemistry of the American Chemical Society in connection with the one hundred and sixth annual meeting, which was held at Pittsburgh from September 6 to 10.

DR. ROBERT M. GATES, president of the Air Preheater Corporation, New York, has been elected president of the American Society of Mechanical Engineers. He succeeds Harold W. Coes, of New York. The joint meeting with the Engineering Institute of Canada opened at Toronto for three days on September 30.

EDMUND L. DUNN, of Boston, president of the New England Fish Exchange, was elected president of the Atlantic States Marine Fisheries Commission at the annual meeting recently held at Philadelphia.

THE Western Reserve University Chapter of the Society of Sigma Xi has elected the following officers for 1943: J. C. Gray, *President;* Normand L. Hoerr, *Vice-president;* R. F. Hanzal, *Treasurer,* and Helen A. Hunscher, *Secretary.*

THE election of Dr. Gardner Murphy, chairman of the department of psychology of the College of the City of New York, as president of the American Psychological Association was announced on September 2 at the fifty-first annual meeting of the society at Evanston, Ill. Lieutenant-Commander C. M. Louttit, of the Navy Department, and Professor Donald Marquis, of Yale University, were added to the council of directors. Professor Willard C. Olson, of the University of Michigan, was re-elected secretary for a three-year period, and Professor Willard L. Valentine, of Northwestern University, was continued as treasurer and business-manager of publications. Financial support again was voted for the Office of Psychological Personnel at Washington, D. C. It was decided that recommendations on the reorganization of psychology from the Intersociety Constitutional Convention should be referred to members for a mail ballot.

COLONEL ALBERT S. DABNEY, M. C., U. S. Army, who will retire on November 30 as assistant commandant of the Medical Field Service School at Carlisle Barracks, Pa., has been appointed assistant dean of the School of Medicine of the University of Pittsburgh. The *Journal* of the American Medical Association states that Colonel Guy B. Denit, M. C., U. S. Army, who recently returned from a six-months tour of duty as chief surgeon of a base section in the African theater of operations, will temporarily replace Colonel Dabney as assistant commandant at the Medical Field Service School. A ceremonial retreat parade was held on August 31 in honor of Colonel Dabney, and Brigadier General Addison D. Davis, commanding general of Carlisle Barracks, commended him for his loyal and efficient services. A veteran of two world wars and a medical officer for twenty-seven years, Colonel Dabney had been at Carlisle Barracks since June 27, 1939, first as director of the medical department equipment laboratory and since January 10, 1942, as assistant commandant. Prior to this, he had been executive officer in the Surgeon General's Office at Washington, D. C.

DR. WILLIAM O. HOTCHKISS, president of the Rensselaer Polytechnic Institute, retired on October 1 with the title emeritus. Dr. Matthew A. Hunter, professor and head of the department of metallurgical engineering, has been made dean of the faculty, and Dr. Ray Palmer Baker, assistant director of the institute, has become dean of students.

DR. LOUIS S. GOODMAN, assistant professor of pharmacology at the Yale University School of Medicine, has been appointed professor of pharmacology and physiology and chairman of the department of the College of Medicine of the University of Vermont.

DR. HARRY C. SOLOMON, clinical professor of psychiatry, has been appointed professor of psychiatry at the Harvard Medical School and medical director of the Boston Psychopathic Hospital, succeeding the late Dr. C. Macfie Campbell. Dr. Solomon graduated at Harvard in 1914 and has been a member of the faculty since 1915.

ROBERT L. CUSHING, of the department of agronomy of the University of Nebraska, who has also been associated with the Bureau of Plant Industry and has had charge of the grain sorghum investigations for the Nebraska region, has been appointed assistant professor of plant breeding at Cornell University.

DR. HOWARD REYNOLDS, of the University of Arkansas, has been named assistant professor of bacteriology at Iowa State College. In addition, he will be in charge of research on food bacteriology for the Iowa Agricultural Experiment Station.

DR. JAY MCLEAN, of the Memorial Hospital for Cancer, New York City, has been appointed associate professor of surgical research at the Ohio State University, where he will continue his work on heparin.

DR. CHARLES E. CLARK, professor at the Bradley Polytechnic Institute, has been named associate professor of mathematics at Emory University.

A. W. LING, chief agricultural advisory officer of the University of Bristol, England, has been appointed principal of Seale-Hayne Agricultural College, Newton Abbot.

DR. LESTER KRAMPITZ, of the Rockefeller Institute for Medical Research, has been appointed a research associate at Iowa State College. He will take charge of a study of penicillin to be carried out by the Industrial Science Research Institute.

DR. J. OSBORN FULLER has been appointed assistant professor of geology at West Virginia University, not, as incorrectly reported in a recent issue of SCIENCE, at the University of Virginia.

DR. ALBERT L. ELDER, associate professor of chemistry at Syracuse University, now head consultant to the Chemical Divisions of the War Production Board, has been named special assistant in coordinating penicillin production to Fred J. Stock, chief of the section of drugs.

DR. ARISTID V. GROSSE has been released from the Rubber Director's Office of the War Production Board to become director of research for the Houdry Laboratories of the Catalytic Development Corporation at Marcus Hook, Pa. Dr. Edward R. Gilliland, of the War Production Board, has been appointed an assistant rubber director in charge of research and development.

DR. KENNETH MORGAREIDGE has been appointed head of the Biological Assay Laboratories of the National Oil Products Company. Dr. John R. Foy has been made assistant head of the same laboratories.

DR. MARSHALL C. HECK, since 1941 assistant professor of animal husbandry at the Massachusetts State College, has resigned to become meat specialist for the National Livestock and Meat Board.

DR. CHARLES W. RIPPIE, formerly associated with the Shell Oil Company and Monsanto Chemical Company, has been appointed supervisor of the technical service at Painesville, Ohio, of the Diamond Alkali Company, Pittsburgh.

DR. WILBERT M. CHAPMAN, curator of the department of ichthyology of the California Academy of Sciences, has leave of absence to enable him to serve as senior fisheries specialist for the Office of Economic Warfare.

DR. ALEXANDER G. RUTHVEN, president of the University of Michigan, has been invited by the British Government to spend several weeks in England to make a study of war and post-war education. The project is concerned chiefly with the development of a program of adult education for Great Britain with emphasis on returning soldiers.

THE botanical and geological expedition to the Alaska Military Highway (see SCIENCE, 97: 574, 1943), led by Dr. Hugh M. Raup, of the Arnold Arboretum, returned to Boston on September 17. Leaving Dawson Creek on June 8, the party traversed the highway from Dawson Creek to Whitehorse and return. Notes and botanical collections representing approximately 2,500 field numbers were made, principally in four areas, with miscellaneous material from many other points along the road.

PROFESSORS L. R. LAUDON and H. T. U. Smith, of the department of geology of the University of Kansas, spent the summer in the Northwest Territories of Canada, serving as field geologist and aero-geologist, respectively, on the Canol project of Imperial Oil, Ltd.

DR. H. P. FROES, director of the School of Tropical Medicine of the University of Bahia, Brazil, recently spoke before meetings of students and members of the profession at Baylor Medical School, Houston, and the Medical School of the University of Texas, Galveston. Dr. Froes described the broad sanitary measures being undertaken in Brazil to reduce the menace of the spread of tropical diseases, particularly through increased airplane traffic.

THE American Physical Society will meet at Northwestern University on November 12 and 13. For this meeting a symposium on the physics of rubber and other high polymers is planned. It is expected that Drs. P. Debye, J. H. Dillon, P. H. Emmett, S. D. Gehman, H. M. James, H. Mark, M. Mooney, H. Sack, W. B. Wiegand and L. A. Wood will be among those represented on the program. There will also be the usual sessions for contributed papers, of which announcement will be sent to members of the society about October 25.

THE forty-sixth annual meeting of the American Ceramic Society, Inc., will be held at the Hotel William Penn, Pittsburgh, Pa., from April 2 to 5, 1944. Technical programs and information on post-war ceramic industrial welfare essentials are planned.

COLUMBIA UNIVERSITY opened its one hundred and ninetieth academic year on September 29. Due to the war many new courses are being offered. In the engineering department, fuel technology, synthetic plastics, chemical engineering research, communications electronics and manufacturing processes have been introduced. New language courses include elementary Russian and Japanese.

DR. EDWARD S. ROSS, assistant curator of the department of entomology of the California Academy of Sciences, San Francisco, now in the Sanitary Corps of the Army, and Lieutenant Radcliff Roberts, also of the Sanitary Corps, have published a "Mosquito Atlas of the World."

THE School of Medicine of the University of Texas announces the publication of *Texas Reports on Biology and Medicine,* a quarterly scientific periodical available without charge to the libraries of medical institutions throughout the world.

MEMBERS of the entomological department of the University of Texas plan an expedition to southern Mexico and the desert country near Monterrey with the object of adding to the university's collection of gnats and flies which is said to be the largest in the world. These insects are being used in research on genetics conducted at the university with the aid of a $35,000 grant from the Rockefeller Foundation.

A SPECIAL correspondent from the French Frontier writes to *The Times,* London, as follows: "Since the outbreak of war the deaths in France have exceeded the births by nearly 500,000 and the net decrease in the population for 1942 alone is 93,625, according to the latest official statistical bulletin. The chief cause of the rapid shrinkage of the population is now tuberculosis aggravated by malnutrition, particularly an insufficiency of fats. A second contributory cause is the high infant death-rate, which has risen from 63 per 1,000 in 1939 to 91 in 1940, 75 in 1941 and 70 in 1942. That undernourishment is the basic cause is indicated by the fact that mortality from all causes is far greater in the larger towns than in the country.

DISCUSSION

THE CENSUS BUREAU AND THE GREAT LAKES AREA SITUATION

THIS is a brief reply to the defense of the Census Bureau, by Geographers Batschelet and Proudfoot, in a recent issue of SCIENCE, regarding current inaccuracies in the total area figures for the United States and the Great Lakes States.

We tried unsuccessfully for four years (not quite ten!) to track down the responsibility for these errors, with one federal bureau after another squirming out of it. For fourteen months of this period, we had the assurance of Director Austin that the Census Bureau would clearly show the correct total area figures for the Great Lakes States and the United States in the Census of 1940. News of the reversal of this promise was not conveyed to us until the bureau's official release of April 11, 1941, arrived. The bureau then said it was too late and too expensive to change, and retired to a last-line defense by disclaiming legal status for their area figures. At this point we pursued the librarian of the Congress of the United States to the extent of one letter; and it was that official who laid the responsibility for official area figures squarely at the door of the Census authorities.

The omission of 61,000 square miles from the total area of the United States can not be lightly dismissed as meaning nothing to any one other than Michigan and Great Lakes chauvinists. This is an American domain comparable in area to England, Scotland, Portugal, Austria, Belgium, Bulgaria, Denmark, Greece, Guatemala or Holland—a greater portion of American-owned earth's surface than occupied by any one of twenty-seven states of the Union.

Michigan's Great Lakes water area, say the Census Bureau defenders, has never been denied her. They then proceed to give columns of reasons for excluding Great Lakes area from the total area of Michigan and the other Great Lakes States. This Great Lakes water area is denied in total area figures in all current reference books, which take their facts from the Census Report.

Of course the Census Bureau knows about the Great Lakes areas of the Great Lakes States. All figures in the tabulation that accompanied our original article were gleaned, here and there, from footnotes and subsidiary tables in the 1940 Census Report. The bureau's fault is that its way of hiding the figures (so that, they state, even we missed them), is misleading and the cause of widespread inaccuracies.

The clause in the proposed new Michigan constitution will specify merely that the Great Lakes area of Michigan shall be included in the official total area figure of the state. That will permit the use of more accurate measurements from time to time as these become available.

Difficulty in apportioning Great Lakes water among counties and townships of Great Lakes States is given as a reason for lopping off more than one third of the total area of Michigan and more than a seventh of that of Wisconsin; for short-measuring six other states; and amputating from the United States the area of a good-sized kingdom. This is Procrustean performance, not scientific procedure. Surely the mosaic of statistical interpretations should be fitted to the actual fact, rather than the fact mutilated to facilitate statistics.

The Census Bureau defenders cite practise in regard to various large bodies of water in the world, as arguments to support their method. These seas—most strikingly the Mediterranean and the Baltic—are not at all comparable with the Great Lakes. Significantly they omit Lake Victoria in Africa, Lake Baikal in Siberia and Great Slave, Great Bear and Winnipeg Lakes in Canada, all inland fresh-water bodies as large or larger than Lake Ontario. In these approximately parallel instances, the current practise is to include the water areas in the geographical divisions which possess them or a part of them.

We agree whole-heartedly that it is not the function of the Census Bureau to decide state claims to land or water areas and that it does right to avoid trouble in the matter of coastal water areas to which various states "feel they have a legal claim." But when boundaries are legally established, by treaty, Acts of Congress and decisions of the Supreme Court of the United States, the Census Bureau is bound to respect them, and cease to classify them—for statistical convenience—among boundaries that are nebulous.

It seems necessary to re-emphasize that the international line through the Great Lakes region exists independent of the presence of water. If an earthquake tomorrow should swallow or shift any or all of the Great Lakes, the boundary would still remain exactly where it is to-day.

The Census Bureau's obsessional fear of the political hornet's nest involved in ocean-coastal claims is apparent in the space they devote to that tangled world-situation—which is totally unrelated to the clear division of the Great Lakes waters.

Canada and Ontario view the matter as a simple arithmetical problem—the square measurement of regions within established legal boundaries. Ontario includes its share of the Great Lakes in its total area

because this is legally a part of that province. Canada includes this water area in its total area, because Ontario is a legal part of the Dominion. They rest their case convincingly on the Quebec Act of 1774; the Treaty of Paris of 1783; the Constitutional Act and an Order in Council in 1791; the Union Act of 1840; and the British North America Act in 1867.

The Great Lakes region between the international line and the southern shore of the Great Lakes is a part of the United States and should be included in its total area, by virtue of the Treaty of Paris of 1783.

The Great Lakes region between the international line and the Michigan shoreline of the Great Lakes is within the boundaries of and constitutes a part of the State of Michigan, by virtue of the Ordinance of 1787; Act of Congress for the division of Indiana Territory, 1805; Act of Congress, June 15, 1836, admitting Michigan to statehood; and three Supreme Court decisions (270 U. S. Rep., p. 295; 272, p. 398; 297, p. 550–552).

The proposition that title, jurisdiction and proprietorship of the land under the waters of the Great Lakes is in the adjoining states is recognized and established by the following authorities: *Illinois Central Railroad Co.* v. *People of the State of Illinois,* 146 U. S. Rep. 387; *Murphy* v. *Dunham,* 38 Fed. Rep. 503, Eastern District of Michigan, Brown J.; *Bigelow* v. *Nickerson,* 70 Fed. Rep. 113, 7th Circuit Court of Appeals; Attorney General's Opinions, Volume 6, page 172.

The foregoing citations were given us by the Honorable Edward Gearing Kemp, former Assistant U. S. Attorney General, now chief counsel of the Budget Bureau at Washington. This eminent jurist, after reading the entire correspondence with the Federal bureaus, commented that the "old method of reporting water areas is obviously misleading, and in my opinion, inaccurate."

We have no quarrel with the Census Bureau. Their task is vast and tedious and its difficulties too little appreciated. They have gone forward, in many ways, since the time of Gannett, as they say. Nevertheless, their attitude toward this Great Lakes question gives grave room for suspicion that they need a speedier adjustment to this fast-moving world. Why should they, at a time when this continent is leading the earth in countless ways, hark back for precedents to the chaos of old-world geography, where boundaries are about as permanent as the wake that a ship leaves in the water? Above all, why do this in relation to the great transcontinental boundary of North America, the fixity of which marks a new epoch in history, is the envy of the world and a model for the future?

If the Bureau of the Census persists in being concerned exclusively with statistical involvements, and the General Land Office to be interested in nothing but land areas, and the Geological Survey is motivated chiefly by a desire to cooperate with the foregoing agencies, where is the world and its reference books to look for the answer to the simple arithmetical question: What is the total area of the United States and the Great Lakes States? At present, the prevailing inaccuracies are a shadow on the record of the Census Bureau.

CHASE S. OSBORN
STELLANOVA OSBORN

SAULT STE. MARIE, MICH.

SCALE CURVES IN CARTOGRAPHY

IT is well known that a sphere can not be mapped upon a plane with a uniform scale. Various types of maps are faithful with respect to angles or areas or geodesics, but not to all of them. In the Mercator projection, the scale varies from latitude to latitude. In a general conformal map, the scale varies from point to point (and therefore is a function of the latitude and longitude).

However, if the mapping is not conformal (angles not preserved), then the scale necessarily depends not only upon the point but also upon the direction. Hence the situation is essentially non-isotropic.

We define a *scale curve* as a locus along which the scale does not vary. In the conformal (or isotropic) case, we have merely ∞^1 scale curves; whereas in the non-conformal mappings, we have ∞^2 scale curves. In all conformal maps, the scale curves form a simple family; but in all non-conformal maps, the scale curves form a doubly-infinite family.

Among the famous non-conformal maps are azimuth equidistant projection, azimuth equi-area projection and the various gnomic and orthographic projections. For each of these, the scale varies in a complicated way not usually described geometrically but only analytically. A faithful graphical representation would involve the construction of the double infinity of scale curves. We study these curves (all of which are complicated) in detail. We prove that no mapping of the sphere exists with ∞^2 straight scale curves. *A new class of surfaces is discovered with straight scales.*

The two most famous conformal maps of the sphere are the Mercator projection (1560) and the stereographic projection, essentially known to Ptolemy (150 A.D.). In the former case, the ∞^1 scale curves are parallel straight lines, and in the latter case, they are concentric circles. We prove that these are the only maps where the single infinity of scale curves forms an isothermal family (connected with the Laplace equation). They are also the only maps where the scale curves are parallel. If we demand that the scale curves (in a conformal map) be straight lines,

the unique solution is the Mercator projection. On the other hand, if the scale curves are circles, the only solution is stereographic projection.

In the most general conformal mapping of a sphere upon the plane, the scale function is never harmonic; but it may be a function of a harmonic function. We prove that this phenomenon occurs only in the stereographic and Mercator projections.

The double infinity of scale curves which we find for the general non-conformal mapping of a sphere (or any surface) has special geometric properties. If we consider the curves of the family passing through a fixed point, the locus of centers of curvature is necessarily a *cubic curve*. In a particular case this locus becomes a straight line, that is, the scale curves form a velocity family. This can happen only for a certain class of surfaces, which will be described in detail elsewhere.

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VITAMIN C FROM EVERGREENS

IN the interesting and informative letter by B. Shishkin to the American Association of Scientific Workers published in a recent issue of SCIENCE[1] there is a description of the search by Soviet botanists for a plentiful supply of vitamin C.

> Quite recently it was discovered that needles of ordinary pine trees contain large quantities of vitamin C. . . . During the long siege of Leningrad lack of vitamin C made itself particularly felt, and the decoction made from pine needles played an important role in the prevention of scurvy.

This is an interesting example of the rediscovery by modern scientists of a fact known to a primitive civilization. Francis Parkman,[2] in "Pioneers of France in the New World," written in 1865, describes the trials of Cartier and his men during the winter encampment of 1535–36.

> A malignant scurvy broke out among them. Man after man went down before the hideous disease, till twenty-five were dead, and only three or four were left in health. The sound were too few to attend the sick, and the wretched sufferers lay in helpless despair, dreaming of the sun and the vines of France. The ground, hard as flint, defied their feeble efforts, and, unable to bury their dead, they hid them in snow-drifts. . . .
>
> Cartier, walking one day near the river met an Indian, who not long before had been prostrate like many of his fellows with the scurvy, but who now, to all appearance, was in high health and spirits. What agency had wrought this marvellous recovery? According to the Indian, it was a certain evergreen, called *ameda*, (a spruce, or, more probably, an arbor-vitae), of which a decoction of the leaves was sovereign against the disease. The experiment was tried. The sick men drank copiously of the healing draught,—so copiously indeed that in six days they drank a tree as large as a French oak. Thus vigorously assailed, the distemper relaxed its hold, and health and hope began to revisit the hapless company.

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SPANS TWO CONTINENTS

As a result of extensive studies I have discovered that Hokan, an American Indian language spoken in California and other parts of North America, extends to South America. Hokan previously had been found to extend only as far south as the Subtiaba language of the Pacific slope of Nicaragua, Central America. Evidence for this discovery has been put in the form of a report to the Bureau of American Ethnology which demonstrates the affinity of Hokan to Quechua, an American Indian language spoken in Peru and adjacent parts. This affinity was discovered to comprise completely the phonetics and morphology, and to the identity with Hokan of 258 Quechua words. Quechua wi-qe, tear, is found for example to mean eye-water, and to be composed of wi-, eye, compare Pomo ui, eye, and -qe, water, compare Pomo -xa, water.

JOHN P. HARRINGTON

BUREAU OF AMERICAN ETHNOLOGY

SCIENTIFIC BOOKS

STRUCTURAL GEOLOGY

Structural Geology. By MARLAND P. BILLINGS. 473 pp. 336 text figures. 19 plates. New York: Prentice-Hall, Inc. 1942. $4.50.

THIS carefully designed and executed new text devotes sixteen chapters (331 pages) to structural geology, grouped as follows (chapter numbers in parentheses): Mechanical principles (2); Folds (Description, 3; Field study and representation, 4; mechanics and causes, 5); Failure by rupture (6); Joints (7); Faults (Description and classification, 8; criteria for recognition, 9; thrust faults, 10; gravity or normal faults, 11); Secondary foliation and lineation (12); Unconformities (13); Salt Domes (14); Plutons (15); Granite tectonics (16); Extrusive igneous rocks (17).

[1] B. Shishkin, SCIENCE, 97: 354, 1943.
[2] Francis Parkman, "Pioneers of France in the New World." Little, Brown and Co., nineteenth edition, p. 194, 1882.

Two additional chapters give a concise introduction to two borderland fields of rapidly growing importance to Structural Geology—Structural Petrology (23 pages) and Geophysical Methods (41 pages).

As this table of contents shows, primary structures of sediments are dealt with only incidentally in connection with the "determination of top of beds" in the chapter on field study and representation of folds. The compaction of sediments and the resulting structures are given twenty lines and a sequence of three purely diagrammatic text figures. The plains' type of folds is neither mentioned by name nor distinguished adequately in word or illustration. The scanty treatment of structural features which dominate the relatively undisturbed regions must disappoint the petroleum geologist. But this is more than offset by the refreshingly new and comprehensive treatment of plutonic and volcanic rock structures (71 pages) which had been correspondingly neglected in some text-books. This must please the ore geologist.

There is no chapter on the problems of isostasy, epirogenesis and orogenesis and speculations concerning their ultimate causes, subjects which have always been popular among young students and have furnished topics for innumerable "bull sessions." The whole subject has been avoided deliberately by the author because it "can be intelligently studied only by geologists with a broad background in many fields of geology." This is eminently true. Nothing, in fact, tends to discredit geological thinking more in the minds of gifted students and endangers the mental processes of all more than the recital of spectacular hypotheses without a thorough analysis of all the elements of observation and reasoning from which they have grown.

To the reviewer it seems, nevertheless, that the broad facts concerning the structural patterns of continents and oceans, the distribution of the major zones of folding and faulting, of earthquake and volcanic activity deserve a place in such a text-book, divorced from all speculation concerning causes. One good reason for their omission suggests itself: Our undergraduates can not be expected to possess any knowledge of place geography or to own an adequate atlas.

While this particular thought may not have influenced the author, concern for the undergraduate mind is evident throughout the book. It is deliberately and effectively designed for instruction at the undergraduate level in United States colleges. Correspondingly, no knowledge of the basic sciences is assumed. For the college student in these United States can not be counted upon to possess any, as those responsible for the training of technicians in the Armed Forces have found out. Moreover he must not be made painfully aware of his deficiency, and he is not apt to have learned as yet to make it up on his own initiative. Accordingly, such physical concepts and knowledge as are needed in structural geology have to be explained explicitly. The chapter on mechanical principles, for instance, devotes three full pages to the definition of "force" and to the "composition and resolution of forces."

Under the circumstances this is as it should be. With so low a start in basic knowledge, one can not, of course, go far in the attempts to explain structural geological phenomena in terms of the modern physics of materials. This the author has recognized.

But there is an enormous contrast between the physics required for the understanding of the second chapter and the last one. The student who needs the elementary explanations of the former simply can not grasp the latter. This constitutes no blemish of the book. It merely means that the last chapter (perhaps the last two chapters) should be fully assigned only to students with sufficient preparation.

The undergraduate in the United States is also accustomed to receive his mental food meticulously prepared in the most digestible form. The author has, accordingly, taken great pains to write as simply as possible, to reduce all illustrations to the simplest form, and to avoid, as far as possible, or reduce to a minimum all critical discussions of matters that are as yet little understood.

To the reviewer this process seems to have been carried farther than is necessary. Structural geology is but in its youth. Its uncertainties are a constant challenge to active minds. Somehow that side of it does not crop out as much as the reviewer should like to see it. Similarly, the preponderance of generalized diagrams, over three fourths of all text figures, tends to give a final and abstract air to the matters discussed.

The same characteristics, on the other hand, enable the instructor to introduce concrete illustrations and discussions from his own experience without largely duplicating the contents of the chapters. It is evident that the book was cast deliberately in that form with that end in view. The book is, thus, an efficient tool for college instruction and not primarily a book for self-study. This is shown also by the collection of practical exercises which conclude the book. These occupy 55 pages and constitute an integral and eminently valuable part of the work.

Turning to individual items, the reviewer is glad to see the words "pitch" and "plunge" given fixed status as technical terms for angles between lines in space; the former, to designate the angle between the line of strike of an inclined plane and another line in the same plane; the latter, for the angle between the horizontal and an inclined line, measured in a vertical plane. Thus, striations "pitch" with reference to the

line of strike of a fault, and "plunge" with reference to sea level.

The reviewer is also glad to see a false statement, "commonly made in geological literature," sharply corrected, having once, in good faith, helped to spread it in print, *viz.*, that the angle of shear is greater than 45 degrees in "ductile" materials.

In other respects, however, the discussion of failure by rupture is open to criticism. If the angle of sheer is "always less than 45 degrees" in the direction of greatest shortening (p. 102) it is not feasible to interpret systems of rectangular joints as shear planes (pp. 126 and 127) or to say that the shear fractures are "approximately parallel" to the circular sections of the strain ellipsoid which form a strongly obtuse angle in the direction of the greatest shortening (p. 109).

In general, the strain ellipsoid is given the lip service usual among American geologists, but it is not introduced where it belongs first of all: in the explanation of the results of laboratory compression and tension tests. For such cases an obviously megascopic "imaginary sphere" is introduced inside the cylinder or square prism that is undergoing compression (p. 101). In both objects it is said to be deformed into an oblate spheroid.

This is, of course, not true in the case of the square prism. The "imaginary sphere" does not explain why the fractures form a cone in one case and a four-sided pyramid in the other. The absence of the concept of the strain-ellipsoid from so basic a discussion shows that it is not introduced at all in the truly valid sense.

Actually in this text, as in most writings of geologists who use it, the word "strain ellipsoid" stands for a two-dimensional figure of an ellipse, which is placed on the picture of a geologic structure in such a way that its axes point respectively in the directions of greatest (relative) shortening and lengthening. Into this figure diagonal lines are drawn to suit the writer's imagined needs: now intersecting at right angles (Fig. 109, p. 127) now at highly obtuse angles which face in the direction of greatest shortening, both strictly contrary to all laboratory evidence, and never, not once, in the only direction justified by the facts set forth at the start.

No wonder this devise is praised as "exceedingly useful if it is employed with discrimination." This matter obviously needs revision in the second edition.

In the discussion of the larger aspects of rupturing, of thrusts and faults, the rôle that plastic deformation, solid flow, plays in rock deformation seems to the reviewer too much neglected. Thrust sheets and fault blocks are more than lumps of inert matter that are set in motion by forces wholly outside of them. They are invariably parts of larger rock bodies every particle of which is in active upward, outward, or sideward movement, the planes of rupture representing discontinuities in the rate of movement. Seen in that light, the author's general use of the term "gravity fault" appears downright indefensible. Failure to give it the attention it deserves accounts for the wholly inadequate treatment of the structures that characterize the folding in the Swiss Alps. It also explains why the author has given over 90 lines and 8 text figures to the discussion of drag folds, while he refers in only four and a half lines to the type of minor folding that abounds in crystalline limestones and schists.

Further recitations of differences in bias or emphasis between the reviewer and author would tend to obscure the basic fact concerning this book: It is a text-book of high merit, written in simple language, easy to read (being printed in large type), forthright in its approach to the concrete matters of terminology and basic principles, methods and technique in structural geology which are indispensable as a foundation for practical work.

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SPECIAL ARTICLES

BIOLOGICAL EFFECTS OF A TOXIC AND A SENSITIZING SUBSTANCE ISOLATED FROM PARAFFIN OIL EXTRACT OF DEAD TUBERCLE BACILLI[1]

IT is a well-known and remarkable fact that killed tubercle bacilli retain many important properties characteristic of the living organism. The nature of the lesions which develop at the site of inoculation and the sensitization to old tuberculin (an almost infallible test of infection) which it confers on animals, has always shown clearly that the dead bacilli have the same specificity of action as that of living ones.

The effects of dead tubercle bacilli become quite comparable to those of living organisms with regard to lesions and sensitization if the dead bacilli are suspended in paraffin oil instead of saline solution. The experiments of Hagan and Levine,[2] Opie and Freund,[3] Coulaud,[4] Saenz[5] and Noel Rist[6] established clearly

[1] This study was carried on under a grant from the Josiah Macy Junior Foundation.

[2] Hagan and Levine, *Jour. Am. Vet. Med. Asn.*, 8: 728, 1932.

[3] E. Opie and J. Freund, *Jour. Exp. Med.*, 66: 761, 1937.

[4] Coulaud, *Rev. de le Tub.*, p. 850, 1934.

[5] A. Saenz, *Revue d'immunologie*, p. 530, 1937.

that the inoculation of paraffin oil suspensions of heat-killed tubercle bacilli produce a sensitization to old tuberculin (O.T.) at least as intense as that given by living virulent bacilli (and much more intense than that given by the same amount of dead bacilli in saline solution). The oil suspensions also provoked the appearance of lesions far from its site of inoculation, whereas suspension in saline gives merely local lesions. All workers agree that pure paraffin oil alone does not produce these effects.

In spite of achieving such results, approaching more and more closely to those induced by living bacilli, workers in the field were still of the opinion that the whole organism was necessary to produce the effects. This opinion was strengthened by the numerous unsuccessful efforts to sensitize normal animals to O.T. with substances extracted from tubercle bacilli.

In attempting to answer the question as to the nature of the mechanism by which paraffin oil enhances the effects of dead bacilli, it occurred to me that it might consist of the removal of substances from the bacilli by the oil. In such a case one should be able to find an active principle in oil which had been in contact with the dried dead (killed by autoclave) bacilli.

Such oil was subjected to prolonged centrifugation, which separated it from the suspended bacilli. The resulting oil differed from the pure oil in viscosity, absorption spectra and specific fluorescence. Moreover, biological controls, after centrifugation at 80,000 r.p.m. for 24 hours, confirmed the fact that this oil was free of bacilli.

I have been able to show that this oil extract contains an active antigen which precipitates with tuberculous rabbit serum. The inoculation of this oil stimulated the formation of antibodies in rabbits and produced a definite sensitization to O.T. in guinea pigs.[7] For the first time, therefore, it was possible to sensitize normal animals to O.T. without using the whole dead or living organism.

In attempting to find the material responsible for this sensitization, a toxic substance was extracted from the oil. A precipitate was first obtained from the oil with the aid of dioxane. This precipitate, P, was submitted to extractions with many organic solvents.

Among these, the dried chloroform extract, inoculated into guinea pigs intraperitoneally in paraffin oil, was found to be very toxic, 2 gamma, the smallest dose tried, being sufficient to produce lesions in the lungs and usually killing the animal.[8] The biological results were supervised by Dr. Alfred Boquet, head of the department of tuberculosis at the Paris Pasteur Institute.

The toxic substance proved to be acid-fast and highly birefringent. It shows beautiful colorations in polarized light. Microanalysis of the toxic substance showed it to be free of nitrogen and phosphorus.[9] Hydrolysis with 10 per cent. potassium hydroxide in alcohol separates it into sugars and an acid alcohol which appears to be very similar to the mycolic acid isolated by J. R. Anderson.[10] But neither mycolic acid nor these sugars alone have shown such biological toxicity. It is possible that the toxicity of this polysaccharide is due to an impurity of a protein nature not discernible in the microanalysis. In this case, such an impurity must be active in amounts as small as 0.01 gamma.

The work which had been carried on in Paris (Institut de Biologie Physico-Chimique) was interrupted in June, 1940, by the war. It was resumed at Cornell University Medical College (Dr. Morton Kahn's laboratories) in the spring of 1942. The nature of the sensitizing substance contained in the oil was still unknown as well as the amount necessary to produce sensitization.

From 8 grams of dried human tubercle bacilli (all that was at first available) of the strain H_{37} (single cell, Dr. Morton Kahn) which is of a low virulence, it was not possible to extract the toxic substance in significant amounts. However, from this material, it was found possible to extract a substance which sensitized normal guinea pigs to P.P.D. and also O.T. with a single 1/10 mg injection. The inoculations were made intraperitoneally, the substance being suspended in paraffin oil. It was later possible to sensitize normal animals with the same amount of substance suspended in saline. All these results were supervised by Dr. Morton Kahn.

It was interesting to determine the relative proportion of toxic and sensitizing substances in two different strains of different virulence. Cultures were made with the strains H_{37} (Dr. Kahn) and a strain PB_{15} of a higher virulence isolated by Dr. Florence Seibert on Corper's medium and cultivated by us on Long's medium. It was found that the precipitate, P, from PB_{15} was richer in toxic substance and poorer in sensitizing substance than the precipitate from H_{37}.

Of the animals (8 out of 10) which revealed sensitization to P.P.D. and O.T. five weeks after receiving a single injection of 0.1 of mgr of the sensitizing substance, 5 remained sensitized 10 months later. Three of them were sacrificed to assure us that they were not tuberculous. The two others, as well as three who were no longer sensitized, and five controls then re-

[6] Noel Rist, "L'Allergie conferée par le bacille morts." These de Paris, 1938.

[7] Nine Choucroun, *Compt. Rend., Acad. des Sci.*, 208: 1757, 1939.

[8] *Ibid.*, 210: 511, 1940.

[9] *Ibid.*, June, 1940.

[10] R. G. Anderson, *Jour. Biol. Chem.*, 85: 339, 1929.

ceived (February 9) H_{37} live bacilli. All the animals died before May except the two which were still sensitized. These are still living and in good health. This experiment was only an indication that the sensitizing substance may act as a protective one. Further experiments, now under way, involving 46 animals, appear to confirm this impression.

The sensitizing substance may, therefore, be able, if separated from the toxic material which accompanies it in the whole bacilli, to protect animals against tuberculosis.

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AN INOCULATED PENICILLIN DRESSING

CONCENTRATED and purified penicillin are not available to civilians except in extreme circumstances. For intravenous administration it is desirable to use the purest and most potent product obtainable. There are conditions, however, in which it is possible to use advantageously penicillin of less potency. Wounds, furunculosis, sinus infections, gonorrhea and other infections of the skin or mucous membranes might be so treated.

In order that patients may have the benefits of penicillin treatment not otherwise available we have explored some of the possibilities of the use of the crude product.

The Florey or Oxford Unit is defined as "the amount of penicillin which, when completely dissolved in 50 ml of meat extract broth, just inhibits completely the growth of the test strain of *Staphylococcus aureus*."[1] Thus a solution containing one unit per cc represents a bacteriostatic agent against the staphylococcus diluted 50 times. The average production from Czapek's synthetic medium is about 4 units.[2]

Since, in the accounts of the therapeutic use of penicillin, the continuous exposure of the infecting organism to the penicillin is stressed, it seemed possible to us that in surface infections the substance might be produced in contact with the lesion. A dressing 5 cm × 5 cm composed of eight layers of gauze was placed in a Petri dish and saturated with a medium containing 1 per cent. yeast extract, 2 per cent. dextrose, 2 per cent. corn starch and 2 per cent. glycerine. This was autoclaved and inoculated with penicillium. After two days at room temperature 1 cc of sterile human plasma was allowed to flush underneath the dressing to simulate as well as possible its application to an open wound. At intervals, shown in the protocol below, the Petri dish was tipped so that the small amount of liquid would drain away from the gauze. This was titrated by the ring test and dilution method. Fresh plasma was substituted under the dressing for that withdrawn. (See Table 1.)

TABLE 1

TITRATION OF PENICILLIN PRODUCED ON INOCULATED DRESSING

Days after inoculation	Diameter of ring test	Units of ring test	Dilution of complete inhibition	Units by dilution method
3	30 mm	5 +	.....	...
4	22	.75	.....	...
6	24	1.0	1 : 200	4
7	..	...	1 : 200	4
8	21	.75	.....	...
10	10	.25	1 : 10	.20
3 Control washed with salt sol.	25	1.5	.....	...

It is impossible to say that these *in vitro* tests represent the exact conditions which would result in the application of the dressing to a lesion, yet the tests demonstrate that a fair amount of penicillin is produced over a period of 4 or 5 days and a bacteriostatic condition would be maintained at the point of contact with the lesion.

Clinical application of the penicillium inoculated gauze dressings and the crude liquid penicillin was made, employing patients who had not been relieved by other acceptable forms of therapy.

One patient had an acute osteomyelitis and periostitis of the right humerus of two weeks' duration. A previous wide incision had been made over the site of the lesion and sulfonamides were prescribed without relief. An inoculated gauze dressing was planted over the wound. Within three hours there was less pain, and in ten days the patient was discharged from the hospital clinically well.

Another patient who had a large furuncle on the back of his neck was treated by injecting the crude liquid penicillin into the open crater and by the local application of an inoculated gauze dressing. Three days later the patient was relieved of all discomfort and the wound was granulating.

A third patient had multiple soft tissue abscesses over his lower back and sacral region. This infection has been recurring regularly for three years. The infecting organism was a *Staphylococcus aureus*. His last period of hospitalization under accepted methods of therapy has been of six months' duration. Crude liquid penicillin was injected into the abscesses and their sinuses and penicillin inoculated gauze dressings were placed over the larger abscesses. This patient is remarkably improved and is still under treatment.

Two other cases of chronic osteomyelitis and periostitis of the femur are being treated with the crude liquid penicillin and the inoculated penicillin gauze

[1] H. W. Florey and M. A. Jennings, *Brit. Jour. Exp. Path.*, 23: 120, 1942.

[2] E. P. Abraham and E. Chain, *Brit. Jour. Exp. Path.*, 23: 103, 1942.

dressings. These patients are clinically improved, but final evaluation will await a subsequent report.

Our laboratory observations and limited clinical experience indicate that this method of treating acute and chronic pyogenic surface infections may hold promise of a possible addition to our therapeutic armamentarium.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN AUTOMATIC FLOW SWITCH FOR WATER-COOLED APPARATUS

IT is often desirable in the continuous operation of a water-cooled apparatus, such as a diffusion pump, to have an automatic device to stop the heating should the flow of cooling water drop appreciably or even stop. A simple and easily constructed device for the protection of such apparatus is described.

The switch was made from 8 mm pyrex tubing as shown in Fig. 1. Two sealed-in leads of tungsten

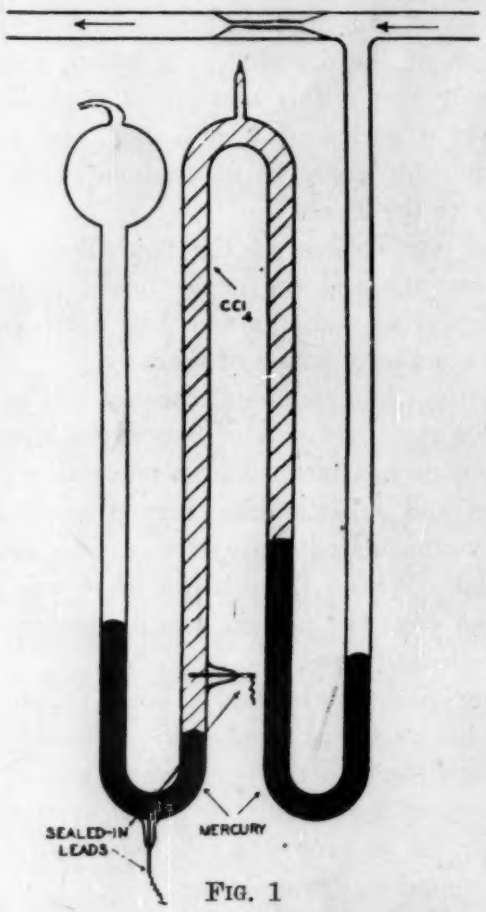

FIG. 1

wire were used for contacts. The two U-tubes are approximately twenty cm in height, but the dimensions are, of course, not critical. Two U-tubes in series are necessary to prevent ordinary chlorinated tap-water from coming in contact with the leads. The size of the orifice is 2 to 3 mm and must be varied with the flow rate desired. The two U-tubes are partially filled with mercury, with the intervening space filled with either an inert liquid or air. The use of a column of air to connect the two mercury columns renders the switch extremely sensitive to slight pressure changes.

The switch is inserted in the cold water inlet of the condenser or other water-cooled apparatus, and as long as sufficient cooling water is flowing the mercury in each U-tube stands at different heights. Should the flow of water cease, however, the mercury is restored to the normal level and electrical contact is made between the two sealed-in wires. The switch is connected in series with a normally closed relay to break the heater circuit when the flow of water ceases.

If the uppermost sealed-in lead is built into the opposite arm of the U-tube, the mercury is in contact with the two leads as long as the water is flowing, and in this case the circuit is broken rather than closed by a drop in flow rate of cooling water. Thus, the switch can be constructed so that failure of cooling water supply will either complete or break an electrical circuit, and hence the switch can be used with either a normally closed or normally open relay depending upon which side of the U-tube the contact wire is inserted. If the heater current is reasonably low the switch itself can be used directly in the heater circuit without the use of a relay.

This safety device was developed during an investigation which was supported by a grant from the Abbott Fund of Northwestern University.

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BOOKS RECEIVED

HAAGENSEN, C. D. and WYNDHAM E. B. LLOYD. *A Hundred Years of Medicine.* Illustrated. Pp. xii + 444. Sheridan House, Inc. $3.75.

KELLS, LYMAN M. *Calculus.* Illustrated. Pp. viii + 509. Prentice-Hall, Inc. $3.75.

MORGAN, CLIFFORD T. *Physiological Psychology.* Illustrated. Pp. xii + 623. McGraw-Hill Book Company. $4.00.

ROBERTSON, G. ROSS. *Laboratory Practice of Organic Chemistry.* Pp. x + 369. Macmillan Company. $2.50.

Smithsonian Institution. Annual Report of the Board of Regents Showing the Operations, Expenditures, and Condition of the Institution for the Year Ended June 30, 1942. Illustrated. Pp. xiii + 421. U. S. Government Printing Office. $1.50.

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STRONG, EDWARD K. *Vocational Interests of Men and Women.* Illustrated. Pp. xxix + 746. Stanford University Press. $6.50.

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ZEMANSKY, MARK W. *Heat and Thermodynamics.* Illustrated. Pp. xiv + 390. McGraw-Hill Book Company. $4.00.